

## WATER RESOURCES POTENTIAL

### Surface water potential

the amount of water that can be actually put to beneficial use is much less due to severe limitations posed by Physiography, topography, inter-state issues and the present state of technology to harness water resources economically. The recent estimates made by the Central Water Commission, indicate that the water resources is utilizable through construction of structures is about 690 cubic km (about 36% of the total). One reason for this vast difference is that not only does the whole rainfall occur in about four months a year but the spatial and temporal distribution of rainfall is too uneven due to which the annual average has very little significance for all practical purposes.

Monsoon rain is the main source of fresh water with 76% of the rainfall occurring between June and September under the influence of the southwest monsoon. The average annual precipitation in volumetric terms is 4000 cubic km. The average annual surface flow out of this is 1869 cubic km, the rest being lost in infiltration and evaporation.

### Ground water potential

The potential of dynamic or rechargeable ground water resources of our country has been estimated by the Central Ground Water Board to be about 432 cubic km.

**Ground water recharge** is principally governed by the intensity of rainfall as also the soil and aquifer conditions. This is a dynamic resource and is replenished every year from natural precipitation, seepage from surface water bodies and conveyance systems return flow from irrigation water, etc.

The highlighted terms are defined or explained as under:

**Utilizable surface water potential** This is the amount of water that can be purpose fully used, without any wastage to the sea, if water storage and conveyance structures like dams, barrages, canals, etc. are suitably built at requisite sites.

**Ground water recharge** Some of the water that precipitates, flows on ground surface or seeps through soil first, then flows laterally and some continues to percolate deeper into the soil. This body of water will eventually reach a saturated zone and replenish or recharge groundwater supply. In other words, the recuperation of groundwater is called the groundwater recharge which is done to increase the groundwater table elevation. This can be done by many artificial techniques, say, by

constructing a detention dam called a water spreading dam or a dike, to store the flood waters and allow for subsequent seepage of water into the soil, so as to increase the groundwater table. It can also be done by the method of rainwater harvesting in small scale, even at individual houses.

### **WATER RESOURCES PLANNING**

The main sources of water supply are surface and ground water which have been used for a variety of purposes such as drinking, irrigation, hydroelectric energy, transport, recreation etc. Often, human activities are based on the „usual or normal“ range of river flow conditions. However, flows and storage vary spatially and temporally; and also they are finite (limited) in nature i.e., there is a limit to the services that can be expected from these resources. Rare or „extreme“ flows or water quality conditions outside the normal ranges will result in losses to river-dependent, human activities. Therefore, planning is needed to increase the benefits from the available water sources. The purpose of water resources planning and management activities is to determine

- (i) How can the renewable yet finite resources best be managed and used?
- (ii) How can this be accomplished in an environment of uncertain supplies and uncertain and increasing demands, and consequently of increasing conflicts among individuals having different interests in the management of a river and its basin?

### **DEVELOPMENT OF WATER RESOURCES**

Due to its multiple benefits and the problems created by its excesses, shortages and quality deterioration, water as a resource requires special attention. Requirement of technological/engineering intervention for development of water resources to meet the varied requirements of man or the human demand for water, which are also unevenly distributed, is hence essential.

The development of water resources, though a necessity, is now pertinent to be made sustainable. The concept of sustainable development implies that development meets the needs of the present life, without compromising on the ability of the future generation to meet their own needs. This is all the more important for a resource like water. Sustainable development would ensure minimum adverse impacts on the quality of air, water and terrestrial environment. The long term impacts of global climatic change on various components of hydrologic cycle are also important.

## **NEED FOR PLANNING AND MANAGEMENT**

Planning and management of water resources systems are essential due to following factors:

- (1) Severity of the adverse consequences of droughts, floods and excessive pollution. These can lead to
  - a. Too little water due to growing urbanization, additional water requirements, instream flow requirements etc. Measures should be taken to reduce the demand during scarcity times
  - b. Too much water due to increased flood frequencies and also increase in water requirements due to increased economic development on river floodplains
  - c. Polluted water due to both industrial and household discharges
- (2) Degradation of aquatic and riparian systems due to river training and reclamation of floodplains for urban and industrial development, poor water quality due to discharges of pesticides, fertilizers and wastewater effluents etc.
- (3) While port development requires deeper rivers, narrowing the river for shipping purposes will increase the flood level
- (4) River bank erosion and degradation of river bed upstream of the reservoirs may increase the flooding risks
- (5) Sediment accumulation in the reservoir due to poor water quality

Considering all these factors, the identification and evaluation of alternative measures that may increase the quantitative and qualitative system performance is the primary goal of planning and management policies.

## **WATER PRICING**

- 1 Pricing of water should ensure its efficient use and reward conservation. Equitable access to water for all and its fair pricing, for drinking and other uses such as sanitation, agricultural and industrial, should be arrived at through independent statutory Water Regulatory Authority, set up by each State, after wide ranging consultation with all stakeholders.

2 In order to meet equity, efficiency and economic principles, the water charges should preferably / as a rule be determined on volumetric basis. Such charges should be reviewed periodically.

3 Recycle and reuse of water, after treatment to specified standards, should also be incentivized through a properly planned tariff system.

4 The principle of differential pricing may be retained for the pre-emptive uses of water for drinking and sanitation; and high priority allocation for ensuring food security and supporting livelihood for the poor. Available water, after meeting the above needs, should increasingly be subjected to allocation and pricing on economic principles so that water is not wasted in unnecessary uses and could be utilized more gainfully.

5 Water Users Associations (WUAs) should be given statutory powers to collect and retain a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction. WUAs should be given the freedom to fix rates subject to floor rates determined by WRAs.

6 The over-drawal of groundwater should be minimized by regulating the use of electricity for its extraction. Separate electric feeders for pumping ground water for agricultural use should be considered.

### **CONSERVATION OF RIVER CORRIDORS, WATER BODIES AND INFRASTRUCTURE**

1 Conservation of rivers, river corridors, water bodies and infrastructure should be undertaken in a scientifically planned manner through community participation. The storage capacities of water bodies and water courses and/or associated wetlands, the flood plains, ecological buffer and areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner to balance the flooding, environment and social issues as per prevalent laws through planned development of urban areas, in particular.

2 Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and wherever it has taken place, it should be restored to the extent feasible and maintained properly.

3 Urban settlements, encroachments and any developmental activities in the protected upstream areas of reservoirs/water bodies, key aquifer recharge areas that pose a potential threat of contamination, pollution, reduced recharge and those endanger wild and human life should be strictly regulated.

4 Environmental needs of Himalayan regions, aquatic eco-system, wet lands and embanked flood plains need to be recognized and taken into consideration while planning.

5 Sources of water and water bodies should not be allowed to get polluted. System of third party periodic inspection should be evolved and stringent punitive actions be taken against the persons responsible for pollution.

6 Quality conservation and improvements are even more important for ground waters, since cleaning up is very difficult. It needs to be ensured that industrial effluents, local cess pools, residues of fertilizers and chemicals, etc., do not reach the ground water.

7 The water resources infrastructure should be maintained properly to continue to get the intended benefits. A suitable percentage of the costs of infrastructure development may be set aside along with collected water charges, for repair and maintenance. Contract for construction of projects should have inbuilt provision for longer periods of proper maintenance and handing over back the infrastructure in good condition.

8 Legally empowered dam safety services need to be ensured in the States as well as at the Centre. Appropriate safety measures, including downstream flood management, for each dam should be undertaken on top priority.

## **PROJECT PLANNING AND IMPLEMENTATION**

1 Considering the existing water stress conditions and the likelihood of further worsening situation due to climate change and other factors, water resources projects should be planned as per the efficiency benchmarks to be prescribed for various situations.

2 Being inter-disciplinary in nature, water resources projects should be planned considering social and environmental aspects also in addition to techno-economic considerations in consultation with project affected and beneficiary families. The integrated water resources management with emphasis on finding reasonable and generally acceptable solutions for most of the stakeholders should be followed for planning and management of water resources projects.

3 Considering the heavy economic loss due to delay in implementation of projects, all clearances, including environmental and investment clearances, be made time bound.

4 Concurrent monitoring at project, State and the Central level should be undertaken for timely interventions to avoid time and cost over-runs.

5 All components of water resources projects should be planned and executed in a pari-passu manner so that intended benefits start accruing immediately and there is no gap between potential created and potential utilized.

6 Local governing bodies like Municipalities, Corporations, etc., and Water Users Associations, wherever applicable, should be involved in planning of the projects. The unique needs and aspirations of the Scheduled caste and Scheduled Tribes, women and other weaker sections of the society should be given due consideration.

7 All water resources projects, including hydro power projects, should be planned to the extent feasible as multi-purpose projects with provision of storage to derive maximum benefit from available topology and water resources.

### **MANAGEMENT OF FLOOD & DROUGHT**

1 While every effort should be made to avert water related disasters like floods and droughts, through structural and non-structural measures, emphasis should be on preparedness for flood / drought with coping mechanisms as an option. Greater emphasis should be placed on rehabilitation of natural drainage system.

2 Land, soil, energy and water management with scientific inputs from local, research and scientific institutions should be used to evolve different agricultural strategies and improve soil and water productivity to manage droughts. Integrated farming systems and non-agricultural developments may also be considered for livelihood support and poverty alleviation.

3 In order to prevent loss of land eroded by the river, which causes permanent loss, revetments, spurs, embankments, etc., should be planned, executed, monitored and maintained on the basis of morphological studies. This will become increasingly more

important, since climate change is likely to increase the rainfall intensity, and hence, soil erosion.

4 Flood forecasting is very important for flood preparedness and should be expanded extensively across the country and modernized using real time data acquisition system and linked to forecasting models. Efforts should be towards developing physical models for various basin sections, which should be linked to each other and to medium range weather forecasts to enhance lead time.

5 Operating procedures for reservoirs should be evolved and implemented in such a manner to have flood cushion and to reduce trapping of sediment during flood season. These procedures should be based on sound decision support system.

6 Protecting all areas prone to floods and droughts may not be practicable; hence, methods for coping with floods and droughts have to be encouraged. Frequency based flood inundation maps should be prepared to evolve coping strategies, including preparedness to supply safe water during and immediately after flood events. Communities need to be involved in preparing an action plan for dealing with the flood/drought situations.

7 To increase preparedness for sudden and unexpected flood related disasters, dam/embankment break studies, as also preparation and periodic updating of emergency action plans / disaster management plans should be evolved after involving affected communities. In hilly reaches, glacial lake outburst flood and landslide dam break floods studies with periodic monitoring along with instrumentation, etc., should be carried out.

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